UPDATING USE-VALUES OF MISSOURI AGRICULTURAL LAND AND DEVELOPING AND TESTING AN ALTERNATIVE METHODOLOGY FOR THIS PROCEDURE

Final Report
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Kevin C. Moore, Ph.D.
Department of Agricultural Economics
University of Missouri-Columbia

This report, concerning updated use-values for Missouri agricultural land, contains three sections: 1. Net returns and use-value estimates for each land grade in the agricultural land classification system for use-value assessments. 2. A brief evaluation of the present Missouri State Tax Commission system for use-value assessments, with special emphasis on recommended future changes. 3. A description and examples of a proposed alternative methodology for calculating use-value updates, along with a discussion of the pro's and con's of the proposed alternative.

1. Net Returns and Use-Value Estimates

Using the most recent available data, net returns and use-values were estimated for the eight soil grade classifications. Table 1 shows the resulting net return per acre and corresponding 1995 use-value for the eight soil grades. Use-values were calculated using supported and unsupported prices. Table 2 presents the trends in use-values from 1989 to the present. Unsupported 1995 use-values are just slightly above 1993 levels for the top two soil grades, but are at or below 1993 levels for the remaining land classes. Supported 1995 use-values follow the same pattern in relationship to 1993 supported price use-values. Soil grade 8 ended up with a negative use-value as a result of negative net returns. USDA estimates of agricultural land values show significantly larger gains in value, coming in at 13.7 % increase from 1993 to 1995.

TABLE 1

1995 USE-VALUE UPDATES

SOIL GRADE	ASSUMED PI MIDPOINT	NORMAL NET RETURN PER ACRE[1]	SUPPORTED NET RETURN PER ACRE[2]	NORMAL VALUE/ACRE[3]	SUPPORTED VALUE/ACRE[4]
1	96.5	$ 95.16	$113.05	$1013.96	$1204.58
2	89.0	$ 77.13	$ 93.63	$ 821.84	$ 997.66
3	80.5	$ 56.70	$ 71.62	$ 604.16	$ 763.13
4	70.5	$ 32.66	$ 45.73	$ 348.00	$ 487.27
5	60.5	$ 18.33	$ 19.83	$ 195.31	$ 211.29
6	47.5	$ 13.86	$ 13.86	$ 147.68	$ 147.68
7	27.0	$ 6.80	$ 6.80	$ 72.46	$ 72.46
8	7.0	$(0.09)	$(0.09)	$ (0.96)	$ (0.96)

[1] USES UNSUPPORTED PRICES

[2] USES SUPPORTED PRICES

[3] UNSUPPORTED VALUE PER ACRE AT .09385 CAPITALIZATION RATE

[4] SUPPORTED VALUE PER ACRE AT .09385 CAPITALIZATION RATE

TABLE 2

TRENDS IN PER ACRE USE-VALUES (1989-95)

SOIL GRADE	1989[1]	1989[2]	1991[1]	1991[2]	1993[1]	1993[2]	1995[1]	1995[2]
1	814	1028	807	1067	983	1166	1013	1205
2	673	870	662	901	810	978	822	998
3	512	691	496	713	614	766	604	763
4	324	480	302	491	383	516	348	487
5	182	269	183	270	194	266	195	211
6	140	140	141	141	148	148	148	148
7	75	75	74	74	77	77	72	72
8	11	11	9	9	7	7	(1)	(1)

[1] UNSUPPORTED VALUE

[2] SUPPORTED VALUE

The values presented here reflect the following updates from the 1993 figures:

1. Crop Rotational Percentages: the rotational percentages for weighting the final net return equations reflect the most current rotations found in Missouri in 1995.

2. State Average Yields: these have been updated using data on yields for the most recent 20 years (1976-95).

3. State Average Prices: prices have been updated using the period 1990-95, a six year average dropping the high and low. This is true for both supported and unsupported prices.

4. Machinery Prices: both list and purchase prices have been updated using an indexing system.

5. Input Prices: prices for seed, fertilizer, chemicals, fuels, interest, storage and wages have all been updated using an indexing system.

6. Pasture Revenue and Expenses: have all been updated including pasture lease price, as well as fencing, fertilizer, establishment, tax and miscellaneous costs.

7. Percent Crop Sales by Month: have been updated using a five year average for 1990/91 through 1994/95.

8. Capitalization Rate: has been updated to reflect a five- year average for 1991 through 1995 of the most common interest rate charged on long-term real estate loans by banks in the 10th (Kansas City) Federal Reserve District.

2. Evaluation of the Process and Areas of Concern Including Recommended Possible Changes

Overall, the process used to estimate use-values is sound. The real problems that arise are the assumptions that were developed in 1982 and held constant since then. Some of the assumptions are obviously not correct for the current time period. The question of whether or not to correct these assumptions is a difficult one. To update and correct these areas would be quite labor intensive. In many cases, the effects upon the final use-values would be very minor. Given that consistency in use-values over time is important, each of the following areas of concern must be evaluated in terms of the bottom-line effect on use-values versus the cost of updating.

1. Assumed statewide PI=62.5. The entire updating procedure hinges on this value being the "true" statewide PI. Effort in this area would make the updating much more accurate if this PI is incorrect or has changed since 1982. Factors affecting this value may include current participation in the conservation reserve program as well as small changes in soil productivity over time.

2. Technology Regression: the procedure to estimate technology effects on crop yields is the regression of yields on rainfall, temperature and a trend variable to capture technology effects in bushels per acre. The procedure itself is probably the best available, but needs to be updated to at least make sure that the hypothesized adjustments to yields are accurate.

3. Typical Machinery Operations: p.40-44, these are the assumed most typical implement sizes, horsepower and "times over" characteristics for Missouri farms in 1982. Research in this area could lead to better estimation of land values by taking into account trends in conservation tillage, more efficient machinery, etc., that have become more popular in recent years.

4. Fertilizer and lime build up and maintenance levels for the various soils used in the study have not changed since the initial study was done in 1982. While these are not expected to change much over time, one needs to keep in mind that a priori, there is an anticipated positive technology effect in bushels per acre from number 2. above. This leads one to believe that subtle changes in varieties that facilitate higher yields may be more or less dependent on the current build up and maintenance levels for nitrogen, phosphorus and potash.

5. Herbicides: the herbicide mixes and application rates used in the update are the same as that for the original study in 1982. Some research needs to be done in this area as trends toward conservation farming as well as consumer preferences over different chemicals evolve.

6. Insecticides: the same is true here as for number 5. above. As better pesticides arrive on the market and conservation practices become more prevalent, predominant insecticide use and rates of application should change over time.

7. Seeding rates used in the update for corn, soybeans, and wheat are the same as those

used for the 1982 report. As farming practices evolve over time (i.e. trend towards narrower rows for corn for example), this may need to be looked into. There are some basic assumptions listed in the original report with regard to percentages of land used in different types of planting practices (i.e. soybeans drilled or planted conventionally) that need to be checked.

8. The assumptions on grain stored (p. 55) while well documented and coming straight from Missouri Farm Facts, may need to be checked. Grain storage amounts are specified by month to capture interest costs associated with crop storage. If the basic assumptions are no longer plausible this could potentially alter interest expense during the year of the update.

9. Hauling charges for each of the three major commodities are not changed for the updating procedure. If more or less grain storage is becoming prevalent and/or different methods of transporting grain are evolving over time, this area needs to be researched in an effort to more accurately capture the costs associated with this portion of production.

10. The assumptions on where grain is stored (i.e. on or off farm) are another area that has not been changed since the initial study was done in 1982. Percentages of on and off farm storage for the three principle commodities are given and may need to be revised. Again, this is done in an effort to capture the interest costs associated with storing grain.

11. Management fees are estimated to be 8% of the landowners share of gross income. Consequently, management fees are assessed at 4% of gross returns because in 1982 average land was leased on a 50-50 crop share lease. Obviously, trends toward alternative leasing arrangements may influence this percentage and need to be evaluated if the updating is to be accurate. Other questions arise in that with more participation in the CRP, is the assumption of a 4% management fee valid for this particular land?

12. Labor hours for the various operations have remained the same since 1982. Wage rates have adjusted, but some attention to the amount of labor used per acre should be given, especially if the machinery sections of the program are changed.

13. Fixed machinery costs are calculated using the SAS statistical program and were developed when the first update was done. While the procedure for the estimation of these costs shouldn't change, the values derived are highly dependent on the type of machinery used on the typical Missouri farm. If these machinery types are altered in any way (as in number 3. above), the fixed costs will obviously change.

14. The method used to evaluate alternative ways to attain average crop prices for the three principle commodities is listed in the original report and at that time the method chosen gave the minimum amount of variation. Subsequent updates have all used the same method. Perhaps the best way to approach this problem would be to re-evaluate all of the ways to average prices when updating occurs and choose the appropriate method by means of the minimum variation criteria. This would insure that the method chosen gives the best estimate of crop prices.

15. When figuring the Net Returns to Pasture equation, returns and expenses are highly dependent on an equation derived and estimated by Jacobs (1981). This particular equation

states that AUM's are linearly related to the productivity index of a given soil. While the method seems appropriate, concerns do arise over whether or not the equation is still accurate 8 years after original implementation. If a better estimate is available, it should be used since this equation is pivotal in determining the "break" between which land is valued as cropland or pasture land. In addition, on the expense side, fertilizer costs are estimated by manipulating this equation since fertilizer levels are assumed to be related to PI. A weighting system is used to do this whereby it is assumed that 30% of all pasture land in Missouri is leased on a per AUM basis. Now the question becomes one of not only the accuracy of the hypothesized equation, but of the validity of the assumption of leasing arrangements to be used in the study.

The weighting scheme used to derive a rental value per AUM has resulted in a continual decline in the rental value, while the survey results which gave the original base value of $6.00 per AUM now report an average of about $7.00 per AUM.

16. Also on the expense side of the pasture equation is the estimate of annual property taxes which are stated to be linearly related to PI. This equation may need to be re-estimated if more accurate use-values are desired.

17. The previous discussion deals exclusively with the numerator of the formula for the capitalization of farming income into perpetuity. The denominator of that equation is much more critical in that small percentage changes, even down to one-hundredth of a percent, can alter estimates of land values drastically. More research in the attainment of the appropriate capitalization rate may be warranted.

Proposed "new" method for calculating updated use-values.

After much thought and trying several alternative "new" methods for calculating use-values of agricultural land, the following procedure is recommended as a superior but simpler method for the Tax Commission to adopt as the means by which use-values are updated. It follows much the same logic as the pasture portion of the existing procedure for updating use-values. Basically changes in crop land and pasture rental values are being suggested as "movers" of the previous net crop and pasture rents, and then these values are capitalized using the new adjusted capitalization rate (the same as under the current procedure) in order to arrive at updated use-values.

Specifically the procedure is as follows:

1. Using crop and pasture rental rates as published in <u>Missouri Farm Facts</u>, calculate the percentage change in each for the period in question. Crop rental rates are calculated using the most recent six years of data, dropping out the high and low and averaging the remaining four years. This follows from the procedure previously used to calculate average crop prices used in figuring net crop returns (i.e. a six-year moving average dropping the high and low). Pasture rental rates are calculated using the most recent five years of data, again following the procedure previously used for figuring average pasture rental rates.

2. Apply the rental rate percentage changes to the rates used previously for calculating use-values. Apply the crop land rental change to land classes 1-4, and the pasture rental changes to land classes 5-8.

3. Calculate the updated discount rate used to capitalize these rental rates into use-values. The capitalization rate used is the same as was used in the previous method. Specifically it is a five-year moving average of the "Most Common Interest Rate on Farm Loans - Long Term Real Estate Loans in the 10th (Kansas City) Federal Reserve District", published in <u>Agricultural Finance Databook,</u> Division of Research and Statistics, Board of Governors of the Federal Reserve System. The quarterly rates are used to calculate a yearly average, and then the five most recent years are used to calculate the five-year average.

4. Calculate the updated use-values for each soil grade (i.e. land class) by dividing the updated rental value by the capitalization rate.

This procedure is illustrated below by calculating the 1995 use-values using the proposed alternative method.

1995 Use-Values as calculated by the proposed "new" procedure.

1995 crop rent ave. (6 most recent yrs take out high and low) = 52.779242
1993 crop rent ave. (6 most recent yrs take out high and low) = 51.461247
Percentage crop rent increase 1993 to 1995 = 2.56 %
1995 pasture rent ave. (5 most recent yrs) = 17.523288
1993 pasture rent ave. (5 most recent yrs) = 17.56822
Percentage pasture rent increase 1993 to 1995 = -.26122 %

1993 Unsupp. Net Crop Revenue	Times 1 plus % change	1995 Calculated Net Crop Revenue	5 yr. Ave. Capitaliz. Rate	1995 Use-Values by "new" method
$100.90	1.0256	$103.48304	.09385	$1102.64
$83.12	1.0256	$85.247872	.09385	$908.34
$62.98	1.0256	$64.592288	.09385	$688.25
$39.28	1.0256	$40.285568	.09385	$429.25
$19.87	.9973878	$19.818095	.09385	$211.17
$15.21	.9973878	$15.170268	.09385	$161.64
$7.87	.9973878	$7.8494419	.09385	$83.64
$0.71	.9973878	$0.7081453	.09385	$7.55

Use-Values and percentage changes using the "new" alternative procedure.

SOIL GRADE	1993 Unsp. Use-Val.	1995 "new" Use-Val.	Percentage Change
1	983	1103	12.2
2	810	908	12.1
3	614	688	12.1
4	383	429	12.0
5	194	211	8.8
6	148	162	9.5
7	77	84	9.1
8	7	8	14.2

Use-Values and percentage changes using the "old" (i.e. existing) procedure.

SOIL GRADE	1993 Unsp. Use-Val.	1995 Unsp. Use-Val.	Percentage Change
1	983	1013	3.0
2	810	822	1.5
3	614	604	(1.6)
4	383	348	(9.1)
5	194	195	0
6	148	148	0
7	77	72	(6.5)
8	7	(1)	N/A

USDA figures: 1993 Ave. Value Land and Buildings = $774
1995 Ave. Value Land and Buildings = $880
Percentage change in MO land values 1993 to 1995 = 13.7 %.

As a test, this alternative method was used to calculate 1993 use-values, in order to see how the procedure would have performed versus the existing method.

1993 crop rent ave. (6 most recent yrs take out high and low) = 51.461247
1991 crop rent ave. (6 most recent yrs take out high and low) = 49.059402
Percentage crop rent increase 1991 to 1993 = 4.89578 %
1993 pasture rent ave. (5 most recent yrs) = 17.56822
1991 pasture rent ave. (5 most recent yrs) = 16.939178
Percentage pasture rent increase 1991 to 1993 = 3.58056 %

1991 Unsupp. Net Crop Revenue	Times 1 plus % change	1993 Calculated Net Crop Revenue	5 yr. Ave. Capitaliz. Rate	1993 Use-Values by "new" method
$90.27	1.0489578	$94.68942	.1026	$922.89
$73.97	1.0489578	$77.591408	.1026	$756.25
$55.50	1.0489578	$58.217157	.1026	$567.42
$33.76	1.0489578	$35.412815	.1026	$345.15
$20.51	1.0358056	$21.244372	.1026	$207.06
$15.76	1.0358056	$16.324296	.1026	$159.11
$8.27	1.0358056	$8.5661123	.1026	$83.49
$0.96	1.0358056	$.9943733	.1026	$9.69

Use-Values and percentage changes if the "new" method had been used in 1993.

SOIL GRADE	1991 Unsp. Use-Val.	1993 "new" Use-Val.	Percentage Change
1	807	923	14.4
2	662	756	14.2
3	496	567	14.3
4	302	345	14.2
5	183	207	13.1
6	141	159	12.8
7	74	83	12.2
8	9	10	11.1

Use-Values and percentage changes from 1993 using the "old" procedure.

SOIL GRADE	1991 Unsp. Use-Val.	1993 Unsp. Use-Val.	Percentage Change
1	807	983	21.8
2	662	810	22.4
3	496	614	23.8
4	302	383	26.8
5	183	194	6.0
6	141	148	4.9
7	74	77	4.1
8	9	7	(22.2)

USDA figures: 1991 Ave. Value Land and Buildings = $723
                  1993 Ave. Value Land and Buildings = $774
                  Percentage change in MO land values 1991 to 1993 = 7.1 %.

Comments, conclusions and concerns about the new versus the old methods.

1. The proposed new method is much simpler and more easily defended against criticism than the old method. It does not rely on old technologies as the base line. But it does have to start from a beginning base line for rental values. The base line used is the net crop and pasture land returns estimated from the "old" procedure when the 1993 use-value updates were computed. As such, the old technologies are embodied in the base line used for the new procedure.

2. The proposed new methodology arrives at a more uniform percentage change for crop and pasture land use-values than did the old method. This is simply due to the way the percentage changes are used as "movers" across four soil grades. The old method can and does result in quite different percentage use-values changes across the soil grades. While one can envision situations where such differential changes could occur, in most cases rents and resulting use-values seem to move together across soil grades from year to year.

3. The proposed method results in use-value changes that are more consistent with the USDA figures for farm real estate value changes. While one would not expect the two series to move exactly together, some strong degree of relationship is foreseen. Certainly taxpayers and politicians would be looking at market values to some extent when predicting what they believe use-values would be doing.

4. The proposed method is designed to minimize any major movements in use-value changes from period to period. Using rental values, which are somewhat slow to adjust themselves, and then taking moving averages will tend to smooth out any major changes in net rental income values. The capitalization rate is typically the most dominant factor influencing use-value adjustments. The use of the five-year moving average tends to moderate this influence.

5. The proposed method is simple enough to be computed at any time, given adequate data. The Tax Commission could examine the changes annually, in order to educate assessors, politicians, etc. as to likely changes in the future. The procedure can easily be performed by staff members of the Tax Commission, eliminating the need to hire University of Missouri assistance.

6. 1995 weighted average crop rents as calculated under the new method using converted crop rents from Missouri Farm Facts, are about 8.6 % below the weighted average of 1995 unsupported crop land net returns as calculated by the old procedure. USDA just revised their survey on rental rates, which resulted in a significant decline in crop and pasture rental rates reported. One would have expected calculated net returns to be below rental rates, as fixed costs such as property taxes are deducted from rents to arrive at net crop and pasture returns. But while the absolute level of rents and/or net land returns can be argued, the changes in rents should give a very close approximation of changes in net land returns.